Physical control of phytoplankton biomass in the Alboran Sea

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Despite the general oligotrophic character of the Western Mediterranean Sea, the Alboran Sea and the Gulf of Lions present relatively steady high surface concentrations of pigments, although there are pronounced blooms in the spring and fall. The circulation in the Alboran Sea is characterized by two quasi-permanent anticyclonic gyres which almost cover the entire basin. This dynamical pattern is ruled by the coexistence and mixing of Atlantic and Mediterranean waters, the variations in mass flux inflow through the Strait of Gibraltar (and Sicily), winds, and topography. The ocean color imagery from the Coastal Zone Color Scanner (CZCS) and early results from the Sea Viewing Wide Field Sensor (SeaWiFS) show that the highest pigment concentrations are associated with the quasi-permanent anticyclonic western gyre and the coastal upwelling off the coast of Malaga. The coincidence of distribution and circulation patterns suggests physical control. In this study we focus on the western anticyclonic gyre, which is characterized by a relatively stable horizontal flow field coupled to downwelling in the core and upwelling in the periphery. Our objective is to compare the role of advective accumulation versus in situ growth (in response to upwelling of nutrients) in the observed pattern of chlorophyll concentration. Time series of horizontal current velocities and satellite-derived biomass are statistically analyzed, together with estimations of the vertical velocity fields and their manifestation (sea surface temperature). We find that upwelling is the primary mechanism controlling the observed phytoplankton biomass. Modelling of the Alboran Sea dynamics is required in future studies, to quantify the coupling between circulation and biological patterns.